Productivity Growth and the Exchange Rate Regime: The Role of Financial Development[1]

Philippe Aghion
Harvard University
NBER

Philippe Bacchetta
Study Center Gerzensee
FAME & CEPR

Romain Ranciere
CREI and IMF

Kenneth Rogoff
Harvard University
NBER

December 23, 2005

[1]We would like to thank Jaume Ventura, Alan Stockman, Eric van Wincoop and several participants at ESSIM 2005, the NBER Summer Institute 2005, and at seminars at Pompeu Fabra, Lausanne, and Zurich for useful comments. Luis Angeles and Guillermo Vuletin provided able research assistance. We acknowledge financial support from the Fondation Banque de France.

Abstract

This paper offers empirical evidence that real exchange rate volatility can have a significant impact on long-term rate of productivity growth, but the effect depends critically on a country's level of financial development. For countries with relatively low levels of financial development, exchange rate flexibility generally reduces growth, whereas for financially advanced countries, there is no significant effect. Our empirical analysis is based on an 83 country data set spanning the years 1960-2000; our results appear robust to time window, alternative measures of financial development and exchange rate flexibility, and outliers. We also offer a simple monetary growth model in which real exchange rate uncertainty exacerbates the negative investment effects of domestic credit market constraints. Our approach delivers results that are in striking contrast to the vast existing empirical exchange rate literature, which largely finds the effects of exchange rate volatility on real activity to be relatively small and insignificant.

1 Introduction

Throughout the developing world, the choice of exchange rate regime stands as perhaps the most contentious aspect of macroeconomic policy; witness the intense international debate over China's exchange rate system. On the one hand, the conventional wisdom in international economic policy circles is that flexible exchange rates are the best option for most countries, outside those contemplating joining a larger economic and currency union. Most developing countries, particularly commodity price exporters, are thought to need more flexible exchange rates as mechanism to help absorb terms of trade shocks. Moreover, it appears that one of the biggest mistakes made by many Asian countries prior to the region's late 1990s financial crisis, was to try to liberalize financial markets without simultaneously making the exchange rate more flexible.

Flexibility may be the new conventional wisdom in international economic policy circles, but relatively fixed exchange rate regimes remain quite popular – and surprisingly durable – throughout the developing world, most famously in Asia, but also in many poorer developing countries.[1] Policymakers have in many cases, strongly resisted outside pressure to make rates more flexible. Who is right? The canonical theoretical literature on choice of exchange rate regime (see the discussion in Obstfeld and Rogoff, 1996, or Garber and Svensson, 1995) would seem to broadly support the case of more flexibility, given the pervasive volatility facing many of these economies. That is especially the case today, when inflation has broadly subsided throughout the developing world, and the case for needing a hard currency peg as an anti-inflation anchor is far weaker than it seemed twenty years ago.

Yet, whereas the conventional theoretical literature points towards allowing more exchange rate flexibility in many developing countries, the empirical evidence is far from decisive. Indeed, since the classic paper of Baxter and Stockman (1989), researchers have had a difficult time demonstrating that a country's choice of exchange rate regime has any systematic effect on macroeconomic performance, for variables ranging for consumption and output volatility to the level or real interest rates. There is some evidence of an effect of exchange rate volatility on trade levels (Frankel and Wei, 1993 and

[1] Calvo and Reinhart (2002) have famously labeled many countries reluctance to allow their exchange rates to float as "fear of floating." See Rogoff et al. (2004) for evidence on the surprising durability of fixed or pegged exchange rate regimes in poorer developing countries that have little de facto international capital market integration.

Rose, 2000). The effect, however, does not appear to be large and it is even less clear that the resulting trade expansion has any great impact on welfare (see Krugman, 1987, or Bacchetta and van Wincoop, 2000). As for the impact on output growth, there is a literature that examines the relationship between exchange rate regimes and growth. The results are typically inconclusive when a broad set of countries is considered, while a link is sometimes found for subsets of countries.[2]

In this paper, we argue that countries with poorly developed financial markets are more sensitive to exchange rate fluctuations and that exchange rate volatility affects their long-term productivity growth. Figure 1 shows the relationship between productivity growth and exchange rate flexibility for countries at different levels of financial development. Panel A considers the volatility of the effective real exchange rate and Panel B considers the exchange rate regime classification proposed by Reinhart and Rogoff (2004). In each case, we compare the residuals of a productivity growth regression on a set of variables with the residuals of an exchange rate flexibility regression on the same variables.[3] By doing so, we obtain adjusted measures of volatility and flexibility that are purged from any collinearity with the standard growth determinants. Countries are ranked in function of their financial development measured by private credit to GDP over five-year averages. The left-hand side of both Panels shows the lower quartile and the right-hand side shows the upper quartile of the distribution. There is clearly a negative relationship between productivity growth and exchange rate flexibility for less financially developed countries, while we see no relationship for the most developed economies.

We take the results in Figure 1 as preliminary evidence that the growth effects of real exchange rate volatility and the flexibility of the exchange rate

[2]See Gosh et al. (2003) for a survey. More recent studies include Levy-Yeyati and Sturzenegger (2003), Razin and Rubinstein (2004), Husain, Mody and Rogoff (2005), De Grauwe and Schnabl (2005), and Dubas et al. (2005). Section 2 discusses this literature in more details. We note that Baldwin (1992), in his analysis of European Monetary Union, argued that a single currency might have growth effects on Europe by reducing the exchange rate premium on capital within Europe.

[3]We perform a pooled regression using five-year average data for 83 countries over 1970-2000. The controls include initial productivity, secondary schooling, financial depth, government expenditure, trade openness, term-of-trade growth and an indicator of banking and currency crises. The variables are defined in Section 2 and in the Appendix. For each quartile, we regress growth residuals on the adjusted measures of real exchange rate volatility and the flexibility of the exchange rate regime.

regime vary with the level of financial development. The existing growth literature does not provide an explanation for these results since there is usually no link between nominal variables and growth. In the first part of the paper we develop a model where exchange rate fluctuations affects the growth performance of credit-constrained firms. We extend the model of volatility and growth developed for the case of a closed and real economy by Aghion, Angeletos, Banerjee, and Manova (2005), henceforth AABM, to the case of an open monetary economy with wage stickiness. We focus on the interaction between nominal exchange rate fluctuations, financial development and productivity growth. The basic mechanism is the following. Suppose that the borrowing capacity of firms is proportional to their current earnings, with a higher multiplier reflecting a higher degree of financial development in the economy. Suppose in addition that the nominal wage is preset and cannot be adjusted to variations in the nominal exchange rate. Then, following an exchange rate appreciation, firms' current earnings are reduced, and so is their ability to borrow in order to survive idiosyncratic liquidity shocks and thereby innovate in the longer term. This, in turn, may help explain why in Figure 1 growth in countries with lower financial development benefits more from a fixed exchange rate regime.[4]

In the second part of the paper, we test our hypothesis by conducting a systematic panel data analysis with a data set for 83 countries over the years 1960-2000. When a country's de facto degree of exchange rate flexibility is interacted with its level of financial development the results prove both robust and highly significant. We consider various measures of exchange rate flexibility, including the volatility of the real effective exchange rate and the exchange rate regime. We use the classification of Reinhart and Rogoff (2004) in the main analysis, but find that our results are robust to other de facto classifications. We consistently find that a high degree of exchange rate flexibility leads to lower growth in countries with relatively thin financial markets. Moreover, these effects are not only statistically significant, they appear quantitatively significant as well. For example, our estimates indicate that a country like Zambia in 1980 with credit to GDP of 15% (which

[4]A related explanation, which can be easily formalized in the context of our model, is that the lower financial development, the more the anticipation of exchange rate fluctuations should discourage R&D investments and therefore growth if these investments were to be decided before firms know the realization of the aggregate shock (since firms anticipate that with higher probability, their R&D investment will not pay out in the long-run as it will not survive the liquidity shock).

lies in the middle of the lower quartile) would have gained 0.94 percent of annual growth had it adopted a totally rigid exchange rate. Even a country like Egypt with credit to GDP of about 27% in 1980 would have gained 0.43 percent growth per year by pegging its exchange rate. Our core results appears to hold intact against a variety of standard robustness tests, including attempts to quarantine the results against outliers and regional effects and allowing for alternative control variables. We also consider alternative measures of exchange rate volatility, as well as considering distance to the technological frontier and degree of market regulation as both alternative, and supplementary, interaction variables.

Our results markedly depart from the dominant view of an exchange rate "disconnect" (Obstfeld and Rogoff, 2001), and in doing so they suggest new directions for research on the choice of exchange rate regime. For example, we show that while exchange rate flexibility has the desirable property to dampen the impact of real shocks, it still has a negative impact of productivity growth in less financially developed economies.

The remaining part of the paper is organized as follows. Section 2 develops a stylized model to rationalize the above Figure 1. In Section 3 we develop our empirical analysis and results. The data are detailed in an appendix, which also includes further robustness tests.

2 A simple model

The negative link between exchange rate flexibility and productivity growth is all the more striking given that no explanation can be found in the existing theoretical literature.[5] However, the basic mechanism we have in mind is straightforward. Exchange rate fluctuations impact firms profits and their ability to innovate and grow. Naturally, firms are more sensitive to these shocks in countries in which borrowing constraints are tighter, that is, in less financially developed economies.

We develop a simple model illustrating this mechanism by relying on three main elements. First, as in AABM, productivity grows as a result of innovation by those entrepreneurs with sufficient funds to meet short-run liquidity shocks. Second, macroeconomic volatility is driven by *nominal* exchange rate

[5] For example, the theoretical literature on exchange regimes has focused on variables such as the level of output or welfare, but not on growth. Moreover, financial development typically does not play a role in this context.

movements in presence of wage stickiness. This monetary feature borrows from the recent New Open Economy Macroeconomics literature. In addition to wage stickiness, we assume that there is a central bank that either fixes the nominal exchange rate or lets it float and follows an interest rate rule. Third, the volatility of the exchange rate is higher than the volatility of other macroeconomic variables, e.g., aggregate productivity, which in turn is consistent with the evidence (see Appendix D for an illustration). We model this by introducing shocks in the foreign exchange market that are exogenous to the real economy.

Our focus in this section is on comparing the impact of different exchange rate regimes on productivity growth, rather than examining the factors that lead a country to choose one or the other regime. In practice, economic ideology, history, political considerations and many other "exogenous" factors almost surely play a role in the choice of exchange rate regime, yet analyzing them goes behind the scope of this paper.

2.1 A small open economy with sticky wages

We consider a small open economy with overlapping generations of two-period lived entrepreneurs and workers. The economy produces a single good identical to the world good. One half of the individuals are selected to become entrepreneurs, while the other half become workers. Individuals are risk neutral and consume their accumulated income at the end of their life. Growth will be determined by the proportion of entrepreneurs who innovate.

Since firms in the small domestic economy are price-takers, they take the foreign price of the good at any date t, P_t^*, as given. Assuming purchasing power parity (PPP), converted back in units of the domestic currency, the value of one unit of sold output at date t is equal to:

$$P_t = S_t P_t^*, \tag{1}$$

where P_t is the domestic price level and S_t is the nominal exchange rate (number of units of the domestic currency per unit of the foreign currency). We will assume that P_t^* is constant and normalize it to 1.[6] Thus, $P_t = S_t$.

In a fixed exchange rate regime, S_t is constant, whereas under a flexible exchange rate regime S_t is random and fluctuates around its mean value $E(S_t) \equiv \overline{S}$. The reason why fluctuations in the nominal exchange rate S_t will

[6] Implicitly we are assuming that the foreign country strictly targets the price level.

lead to fluctuations in firms' real wealth, with consequences for innovation and growth, is that nominal wages are rigid for one period and preset before the realization of S_t. This in turn exposes firms' short-run profits to an exchange rate risk as the value of sales will vary according to S_t whereas the wage bill will not.[7]

For simplicity, we take the wage rate at date t to equate the real wage at the beginning of that period to some reservation value, kA_t. The parameter $k < 1$ refers to the workers' productivity-adjusted reservation utility, say from working on a home activity, and A_t is current aggregate productivity which we first assume to be non-random. We thus have:

$$\frac{w_t}{E(P_t)} = kA_t,$$

where w_t is the nominal wage rate preset at the beginning of period t and $E(P_t)$ is the expected price level. Using the fact that $E(P_t) = E(S_t) = \overline{S}$, we immediately get

$$w_t = k\overline{S}A_t. \tag{2}$$

2.2 The behavior of firms

Individuals who become entrepreneurs take two types of decisions.[8] First, at the beginning of their first period, they need to decide how much labor to hire at the given nominal wage; this decision occurs after the aggregate shocks are realized. Second, at the end of their first period entrepreneurs face a liquidity shock and must decide whether or not to cover it (if they can) in order to survive and thereby innovate in the second period. The proportion ρ_t of entrepreneurs who innovate determines the growth rate of this economy. We first describe production and profits and then consider these two decisions in turn.

[7] In this benchmark model, the interesting measure of the real exchange rate is based on labor costs. The real rate based on price levels becomes of interest once we introduce non-traded goods or distribution services. That real exchange rates are more volatile under a flexible exchange rate regime is documented in Appendix D.

[8] One can easily extend the model so as to allow firms to increase the probability of innovation by investing more in R&D ex ante.

2.2.1 Production and profits

The production of an entrepreneur born at date t in her first period, is given by

$$y_t = A_t\sqrt{l_t},$$

where l_t denotes the firm's labor input at date t.[9]

Given current nominal wages, nominal profits at the end of her first period are given by

$$\Pi_t = P_t y_t - W_t l_t = A_t S_t \sqrt{l_t} - kA_t\overline{S}l_t \quad (3)$$

In her second period, the entrepreneur innovates and thereby realizes the value of innovation v_{t+1}, with probability ρ_t which depends upon two factors: the initial innovation investment and whether the entrepreneur can cover her liquidity cost at the end of her first period. As we shall see, in an economy with credit constraints, the latter depends upon the short-term profit realization and therefore upon both employment and the aggregate shocks in the first period.

Employment in the first period is then chosen by the entrepreneur in order to maximize her net present value:

$$\max_{l_t}\{A_t P_t\sqrt{l_t} - kA_t\overline{S}l_t + \beta\rho_t E_t v_{t+1}\}, \quad (4)$$

where β denotes the entrepreneur's discount rate.

2.2.2 Innovation, liquidity shocks and credit constraints

Innovation upgrades the entrepreneur's technology up by some factor $\gamma > 1$, so that a successful innovator has productivity $A_{t+1} = \gamma A_t$. It is natural to assume that the value of innovation v_{t+1} is proportional to the productivity level achieved by a successful innovator, that is

$$v_{t+1} = vP_{t+1}A_{t+1},$$

with $v > 0$.

Next, we assume that innovation occurs in any firm i only if the entrepreneur in that firm survives the liquidity shock C_t^i that occurs at the end of her first period. Absent credit constraints, the probability of overcoming the liquidity shock would be equal to one, if the value of innovation is larger than

[9] At the end of this section we discuss various extensions of this model.

the cost, and to zero otherwise. In either case, this probability would be independent of current profits. However, once we introduce credit constraints, the probability of the entrepreneur being able to innovate will depend upon her current cash-flow and therefore upon the choice of l_t.

We assume that the liquidity cost of innovation is proportional to productivity A_t, according to the following linear form (multiplied by P_t as it is expressed in nominal terms):

$$C_t^i = c^i P_t A_t,$$

where c^i is independently and identically distributed across firms in the domestic economy, with cumulative distribution function F which we assume to be concave with $F(0) > 0$. While all firms face the same probability distribution over c^i ex ante, ex post the realization of c^i differs across firms. We assume that the net productivity gain from innovating (e.g., as measured by $v\gamma$) is sufficiently high that it is always profitable for an entrepreneur to try and overcome her liquidity shock.

In order to pay for her liquidity cost, the entrepreneur can borrow on the local credit market. However, credit constraints will prevent her from borrowing more than a multiple $\mu - 1$ of current cash flow Π_t. We take μ as being the measure of financial development and we assume that is it constant.[10] The borrowing constraint is no longer binding if μ becomes large.

Thus, the funds available for innovative investment at the end of the first period are at most equal to

$$\mu \Pi_t,$$

and therefore the entrepreneur will innovate whenever:

$$\mu \Pi_t \geq C_t^i. \tag{5}$$

Thus, the probability of innovation ρ_t is equal to[11]

$$\rho_t = \min\{F(\frac{\mu \Pi_t}{S_t A_t}), 1\}. \tag{6}$$

[10] If μ was endogenous, it would decrease with more volatile profits, thus reinforcing the negative impact of exchange rate volatility.

[11] We always have $\rho_t > 0$ since $S_t > 0$.

2.2.3 Equilibrium profits

Now, we can substitute for ρ_t in the entrepreneur's maximization problem. The entrepreneur will choose l_t to maximize (4) which yields

$$l_t = \left(\frac{\alpha S_t}{k\overline{S}}\right)^2$$

and therefore

$$\Pi_t = \psi A_t S_t^2, \tag{7}$$

where $\psi \equiv 1/4k\overline{S}$. We thus see that equilibrium profits are increasing in the nominal exchange rate S_t.

Next, from (6), we can express the probability of innovation as:

$$\rho_t = \min\{F(\mu\psi S_t), 1\}. \tag{8}$$

2.3 Productivity growth and the main theoretical prediction

Expected productivity at date $t+1$ is equal to: $E(A_{t+1}) = E(\rho_t)\gamma A_t + (1 - E(\rho_t))A_t$. Therefore, the expected rate of productivity growth between date t and date $(t+1)$, is simply given by

$$g_t = \frac{E(A_{t+1}) - A_t}{A_t} = (\gamma - 1)E(\rho_t). \tag{9}$$

We can then establish:

Proposition 1 *Moving from a fixed to a flexible exchange rate reduces average growth; the growth gap goes to zero as financial development measured by μ becomes large.*

Proof: First, recall that the average growth rate g_t is proportional to the expected proportion of innovating firms. Thus, to compare a fixed exchange rate (i.e., no exchange rate volatility) with a flexible rate, we just need to look at the difference between the corresponding expected innovation probabilities:

$$\Delta_t = \overline{\rho} - E(\rho_t),$$

where

$$\overline{\rho} = \min\{F(\mu\psi\overline{S}), 1\}$$

and

$$E(\rho_t) = E\left(\min\{F\left(\mu\psi S_t\right), 1\}\right).$$

The first part of the proposition follows immediately from the concavity of F. And the second part follows from the fact that both $F(\mu\psi\overline{S})$ and $E\left(F\left(\mu\psi S_t\right)\right)$ converge to 1 as μ goes to infinity.

Remark 1: *Ex ante R&D investments:* The model can be extended so as to allow firms to choose ex ante how much effort of capital to invest in innovation. Suppose a convex effort cost $C(z)$ of innovating with probability z. Then, the equilibrium innovation probability is equal to

$$z_t\rho_t$$

where z_t is a concave and increasing function of ρ_t. It follows that a mean-preserving spread of S_t will again reduce ex ante expected growth under the assumptions of Proposition 1.

Remark 2: *Convergence:* The model can be turned into a convergence model, for example by assuming that innovating firms catch up with a world technology frontier growing at some rate $\overline{g}$, at a cost which is proportional to the world frontier productivity. Then, based upon the convergence analysis in Aghion-Howitt-Mayer (2005), we conjecture that the lower the degree of financial development in a country, the more likely it is that higher exchange volatility will prevent the country from converging to the world technological frontier in growth rates and/or in per capita GDP levels.

Remark 3: *Distance to technology frontier:* The above variant of our model, also bears the prediction that higher proximity to the world frontier has an ambiguous interaction effect with exchange rate flexibility on growth. On the one hand, countries closer to the frontier have a higher ability to pay for innovation costs that are proportional to frontier productivity. By itself, this effect would produce a positive interaction between proximity to the frontier and exchange rate flexibility. However, the positive interaction between proximity and exchange rate flexibility which we saw in our regression results may have more to do with the fact that economies that are closer to the technological frontier are more capable to survive, or willing to escape, exchange rate volatility than those that are further below the frontier. This latter effect is reminiscent of the escape competition or escape entry effects whereby growth in countries or sectors that are closer to the technological frontier reacts more positively to increased competition or entry threat (see Aghion-Griffith (2005)).

Remark 4: *More general cost distributions and production technologies:* Proposition 1 makes use of the concavity of the cumulative distribution function on liquidity shocks F. First, note that this assumption is satisfied, at least over large intervals, for a large class of density functions. Second, even if this assumption is violated, or with more general production technologies Proposition 1 holds as long as $\overline{\rho}_t$ is sufficiently close to one. The intuition is very simple: in this case, more volatility around $\overline{S}$ implies essentially the same ability to overcome the liquidity shocks in a boom when S_t is high, whereas it implies lower values of S_t and therefore a lower survival probability ρ_t in slumps, all the lower when μ is smaller. It then follows immediately that $\overline{\rho}_t - E(\rho_t)$ is positive. Finally, when $\overline{\rho}_t << 1$, then there is the possibility that more volatility could stimulate innovation and thereby productivity growth in expansions, what we might refer to as a "gambling for resurrection" effect. However, Figure 1 and our regressions in the next section suggest that this latter effect is dominated.

2.4 Endogenous exchange rate

Even though the exchange rate is more volatile than other fundamentals, it is endogenous and is potentially correlated with other variables. In this section, we sketch a simple general equilibrium model where the nominal exchange rate reacts to productivity and risk premium shocks. Assume that domestic productivity is random and can be expressed as:

$$A_t = \overline{A}_t e^{u_t}, \tag{10}$$

where $\overline{A}_t$ is the productivity level determined by period $t-1$ innovation activity, i.e., $\overline{A}_t = (\rho_{t-1}(\gamma - 1) + 1)A_{t-1}$; and u_t is a productivity shock with mean $E(u_t) = 0$ and with variance σ_u^2.

Arbitrage between domestic and foreign bonds by foreign investors gives the following interest parity condition (expressed in logs):

$$s_t = s_{t+1}^e + \ln(1 + i^*) - \ln(1 + i_t) + \eta_t \tag{11}$$

where i_t and i^* represent domestic and foreign nominal interest rates (on one-period bonds) and $s_t = \ln S_t$. The foreign interest rate is taken as given and assumed to be constant.[12] The variable η_t represents a time-varying risk premium determined by investors in the foreign exchange market. Risk-premium shocks are introduced to model the "disconnect" between nominal exchange rate variations and other fundamental variables.[13] The variance of the risk premium is σ_η^2 and we assume that $E(\eta_t) = 0$.

For notational simplicity, we assume that when the exchange rate regime is fixed, it is set at $s_t = 0$. When the exchange rate regime is flexible, the central bank follows an interest rate (or *Taylor*) rule and the exchange rate is determined by the market. In order to stabilize profits, the central bank reacts to exchange rate shocks (equivalent to price level shocks) and to productivity shocks.[14] The rule takes the form:

$$\ln(1 + i_t) = \phi_0 + \phi_1 \cdot s_t + \phi_2 \cdot u_t \tag{12}$$

where we assume that $\phi_0 = \ln(1 + i^*)$ and that ϕ_1 and ϕ_2 are given.

By substituting this rule back into (11), integrating forward and ruling out speculative bubbles, we find that the equilibrium exchange rate can be expressed as:

$$s_t = \frac{1}{1 + \phi_1}\eta_t - \frac{\phi_2}{1 + \phi_1}u_t. \tag{13}$$

In particular, we see that the exchange rate reacts negatively to productivity shocks.

It is straightforward to see that Proposition 1 still holds in this case since the exchange rate is the only variable that affects the probability of innovation. The benefit of a fixed exchange rate is even stronger because under a flexible exchange rate the proportion of innovating firms is negatively correlated with productivity.[15] In a more general model, productivity shocks

[12] A constant foreign interest rate can be justified if we assume a technology with constant real return r^*. Since there is no inflation in the foreign country we have $i^* = r^*$.

[13] Risk-premium shocks come from the behavior of investors who trade for reasons other than the rationally expected return. For example, Jeanne and Rose (2002) and Devereux and Engel (2003) assume that some traders have biased expectations; Duarte and Stockman (2005) assume shocks to perceived covariances; and Bacchetta and van Wincoop (2006) assume hedging trade. The latter show that when investors have heterogenous information, small shocks to hedging trade have a large impact on the exchange rate.

[14] See Woodford (2003) for a discussion of interest rate rules and Kollman (2002) and Obstfeld (2004) for an application in an open-economy context. Kollman also introduces risk premium shocks to generate more realistic exchange rate volatility.

[15] It easy to see that in this case $g_t = (\gamma - 1)E(\rho_t e^{u_t})$. Since ρ_t and e^{u_t} are negatively correlated under a floating rate (but not under a peg) the growth rate is further reduced.

would also affect the innovation probability and a flexible exchange rate would smooth this impact. In this case, Proposition 1 would hold as long as the volatility of productivity shocks is not too large relative to the volatility of risk premium shocks.[16]

3 Empirical analysis

Previous studies have shown that financial development fosters growth and convergence, conditions macroeconomic volatility, or may play a crucial role in financial crises. An interesting question is whether the level of financial development also conditions the impact of monetary arrangements, such as the exchange rate regime. Our basic hypothesis is that the exchange rate regime, or more generally exchange rate volatility, has a negative impact on (long-run) growth when countries are less developed financially.

To test this hypothesis, we consider standard growth regressions to which we add a measure of exchange rate flexibility, as well as an interaction term with exchange rate flexibility and financial development or some other measures of development. In this section, we consider three measures related to exchange rate flexibility: i) the exchange rate regime based on the natural classification of Reinhart and Rogoff (2004), henceforth RR; ii) the standard deviation of the real effective exchange rate; iii) the degree of real "overvaluation", as a deviation of the real exchange rate from its long-term value. We also examine the interaction between terms-of-trade shocks, the exchange rate regime, and growth. We first present the methodology and the variables used and then the results based on a dynamic panel of 83 countries over the 1960-2000 period.

3.1 Data and methodology

As is now standard in the literature, we construct a panel data set by transforming our time series data into five-year averages. This filters out business

[16]Notice that we ignore the impact of interest rate volatility. It is usually argued that interest rates are more volatile under a fixed exchange rate. This would be true in our model if σ_η^2 is the same across regimes. However, it is seems likely that σ_η^2 is lower under a peg. Empirically, interest rates do not appear much more volatile under fixed exchange rates. We found the following nominal interest volatility in our sample: peg: 6.2%; limited flex: 9.2%; managed float: 9.4%; float: 5.4%. Using another classification, Shambaugh (2004) finds that interest rates are more volatile under flexible rates.

cycle fluctuations, so we can focus on long run growth effects. Our dependent variable is productivity growth, rather than total growth. We use the GMM dynamic panel data estimator developed in Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1997) and we compute robust two-step standard errors by following the methodology proposed by Windmeijer (2004).[17] This approach addresses the issues of joint endogeneity of all explanatory variables in a dynamic formulation and of potential biases induced by country specific effects. The panel of country and time-period observations is unbalanced. Appendix B presents the lists of country included in the sample.

Our benchmark specification follows Levine, Loayza and Beck (2000) who provide evidence of a growth enhancing effect of financial development; they were the first to use the system GMM estimation we are using. We consider productivity growth instead of total growth, but our regressions are estimated with the same set of control variables.[18] Starting from this benchmark, we examine the direct effect on growth of our exchange rate flexibility measures. Then, we look at the interaction between these measures and the level of financial development or the distance to the technology frontier. More specifically, we estimate the following equation:

$$y_{i,t}-y_{i,t-1}=(\alpha-1)\,y_{i,t-1}+\gamma_1 ER_{i,t}+\gamma_2 ER_{i,t}*I_{i,t}+\delta I_{i,t}+\beta' Z_{i,t}+\mu_t+\eta_i+\varepsilon_{i,t} \tag{14}$$

where $y_{i,t}$ is the logarithm of output per worker; $ER_{i,t}$ is either the degree of flexibility of the exchange rate regime, real exchange rate volatility, or a measure of overvaluation; $I_{i,t}$ is the dimension of interaction (financial development or distance to frontier); Z_{it} is a set of other control variables, μ_t is the time-specific effect, η_i is the country-specific effect, and $\varepsilon_{i,t}$ is the error term.

[17] It has been recognized that the two steps standard errors are downward biased in a small sample and the Windmeijer (2004) method corrects for that. Notice that, as the two-step estimator is asymptotically efficient, this approach is superior to just relying on first step estimates and standard errors as is common in the empirical growth literature that uses small samples. See Bond (2002) for a simple description of the methodology we follow.

[18] See their table 5, page 55. The other differences with Levine et al. (2000) are that we use a larger data set, we use the Windmejer standard errors, and we include a financial crisis dummy. Loayza and Ranciere (2005) show that their results stay unchanged when the original panel is extended to 83 countries over 1960-2000 and when a crisis dummy is introduced. Levine et al. (2000) show similar results when the same equation is estimated in cross-section with legal origin as external instrument.

Consider the case where $I_{i,t}$ measures financial development. Our hypothesis is that $\gamma_1 < 0$ and $\gamma_2 > 0$ so that the impact of exchange rate flexibility $\gamma_1 + \gamma_2 * I_{i,t}$ is more negative at low levels of financial development. Moreover, when γ_1 and γ_2 have opposite signs, a threshold effect arises:

$$\frac{\delta(y_{i,t} - y_{i,t-1})}{\delta ER_{i,t}} = \gamma_1 + \gamma_2 I_{i,t} > 0 \Leftrightarrow I_{i,t} > \widetilde{I} := -\frac{\gamma_1}{\gamma_2}$$

In Tables 2 to 5, we report threshold levels of financial and technological development above which a more flexible exchange rate becomes growth enhancing. The standard errors of the respective threshold levels are computed using a delta method, that is by taking a first order Taylor approximation around the mean. Notice that in small sample, the delta method is known to result in excessively large standard errors.[19]

We use three measures for the variable $ER_{i,t}$. First, we compute an index of flexibility of the exchange rate regime in each five-year period based on the RR exchange rate classification. Ignoring the free falling category, the RR annual natural broad classification orders regimes from the most rigid to the most flexible: $ERR_t \in \{1, 2, 3, 4\} = \{fix, peg, managed\ float, float\}$. Hence, we construct the index of exchange rate flexibility in each five year interval as:[20]

$$Flex_{t,t+5} = \frac{1}{5} \sum_{i=1}^{5} ERR_{t+i}$$

The second measure we consider for $ER_{i,t}$ is the five-year standard deviation of annual log differences in the effective real exchange rate. We construct the effective rate as a trade-weighted index of multilateral real rates as explained in Appendix A. The third measure is the five-year average deviation from a predicted level of the real effective exchange rate.[21]

[19] An more accurate procedure would be to derive standard errors on thresholds using a bootstrap method.

[20] The information on the flexibility of exchange rate is reported for each country-5 years interval during which the RR classification indicates a non free falling regime for at least 3 out of 5 years.

[21] We compute the average log difference between the actual exchange rate and the exchange rate predicted by country and time specificic characteristics (income per capita, population densisty, regional and time dummies) as in Dollar (1992). We also considered average log differences from a HP detrended multilateral exchange rate series as in Goldfajn and Valdes (1999), and found similar results.

For the interaction variable $I_{i,t}$ we first consider financial development measured as in Levine, Loayza and Beck (2000) by the aggregate private credit provided by banks and other financial institutions as a share of GDP. Second, we use the distance to the world technology frontier measured by initial labor productivity in each five-year period.

The dependent variable is growth in real GDP per worker. Our set of control variables includes average years of secondary schooling as a proxy for human capital, inflation and the size of the government (government expenditure as proportion of GDP) to control for macroeconomic stability, and an adjusted measure of trade openness.[22] A dummy indicating the frequency of a banking or a currency crisis within each five years interval is introduced in the robustness checks. This indicator controls for rare but severe episodes of aggregate instability likely to be associated with large changes in the variables of interest.[23] Definition and sources for all variables are given in Appendix C.

3.2 Exchange rate flexibility and financial development

Tables 1, 2 and 3 present the estimations of the impact of the exchange rate regime, exchange rate volatility and real overvaluation on productivity growth. Each table displays the results of four regressions. The first regression estimates the effects of the exchange rate measure along with financial development and a set of control variables, without interaction term. The second regression adds a variable interacting the exchange rate measure and the measure of financial development in order to test our main prediction: the presence of a *non-linear effect* of exchange rate volatility in the level of financial development. The third and fourth regressions replicate the same regressions with the addition of a dummy variable indicating the frequency of a currency or banking crisis in the five-year interval.

In Table 1, regression [1.1] illustrates the absence of a linear effect of the exchange rate regime on productivity growth. This result is consistent with

[22] More precisely we use the residuals of a pooled regression of (imports + exports)/GDP over structural determinants of trades such as landlock situation, an oil producers dummy, and population.

[23] For instance, Loayza and Hnakovska (2003) present evidence that crisis volatility can explain for an important part the negative relashionship between volatility and growth observed in middle-income economies.

many previous studies.[24] In contrast, regression [1.2] shows that the interaction term of exchange rate flexibility and financial development is positive and significant. The more financially developed an economy, the higher is the point estimate of the impact of exchange rate flexibility on productivity growth. Furthermore, the combined interacted and non-interacted coefficient of flexibility becomes significant at the 5% level (as indicated by the Wald Test in Table 1). Combining these two terms enables us to identify a threshold of financial development below (above) which a more rigid (flexible) regime fosters productivity growth. The point estimate of the threshold is close to the sample mean of the financial development measure. In regressions [1.3] and [1.4], we introduce the crisis dummy described above. While the frequency of crisis has indeed a negative impact on productivity growth, the non-linear effect of exchange rate regime on growth remains robust and its point estimate stays almost unchanged.

The main result of Table 1 is that letting the degree of exchange rate flexibility vary with the level of financial development allows us to identify significant growth effects of the exchange rate regime. The implication is that less financially developed economies may derive growth benefits from maintaining a rigid exchange rate regime. This result provides a novel rational interpretation for the "fear of floating" behavior based on long run productivity growth.

Table 2 presents similar results with exchange rate volatility measured by the five-year volatility of the change in multilateral real exchange rates. Regression [2.1] indicates that exchange rate volatility has a significant negative impact on productivity growth. This effect is economically important: an increase of 50 percent in exchange rate volatility - which corresponds to the mean difference in volatility between a fixed and a flexible exchange rate (see Table 1) - leads to a 0.33 percent reduction in annual productivity growth. This effect is only marginally reduced when we control for the impact of a crisis as in regression [2.3]. Regression [2.2] shows that the interaction between exchange rate volatility and financial development is positive and significant: the more financially developed an economy is, the less adversely

[24] Using the same exchange rate classification, Husain, Mody and Rogoff (2005) do find that developing countries with more flexible exchange rates have historically tended to have lower inflation rates, though they do not find any significant difference in growth rates. They argue informally that fixed rates may be more important for countries with more fragile political and financial institutions, but they do not provide any direct evidence for this view.

is it affected by exchange rate volatility. Here again, the economic impact is important. For instance, consider Chile, whose level of financial depth ranges from 10% in 1975 to 70% in 2000. This drastic change decreases the negative impact of exchange rate volatility on growth by a factor of five. Moreover, our estimate indicates that exchange rate volatility exhibits no significant impact on productivity growth for the set of the most financially developed economies.[25]

Table 3 presents regressions that focus on the effect of real exchange overvaluation. We present the results using the deviation between the actual effective real exchange rate and its predicted value.[26] In the baseline regression [3.1], real overvaluation has a significant and economically important negative effect on growth: a 20% overvaluation translates into a reduction of 0.2% in annual productivity growth (computed from regression [3.1] as 0.99*ln(120/100)). Regression [3.2] studies the effect of interacting real overvaluation and financial development and shows that the more financially developed an economy is, the less vulnerable it becomes to real overvaluations. Using the previous example, a change in financial depth comparable to the one experienced by Chile over 1975-2000 results in a reduction by two of the negative effect of real overvaluation on productivity growth.

The estimation procedure is valid only under the assumption of weak exogeneity of the explanatory variables. That is, they are assumed to be uncorrelated with future realizations of the error term. The consistency of the GMM estimators depends on whether lagged values of the explanatory variables are valid instruments in the growth regression. We address this issue by considering two specification tests suggested by Arellano and Bond (1991) and Arellano and Bover (1995). The first is a Sargan test of overidentifying restrictions, which tests the overall validity of the instruments. Failure to reject the null hypothesis gives support to the model. The second test examines whether the differenced error term is second-order serially correlated. In all regressions, we can safely reject second order serial correlation and the non-validity of our instruments.

[25] These are countries with a private credit to GDP ratio in the range of [90%,120%]. This includes the euro aera, the U.K., Switzerland, Finland, Sweden, the US, and Australia.

[26] We obtain similar results when we consider HP deviation from trend when - as in Golfajn and Valdes - the HP filter parameter is set high enough (lamba=10^8)

3.3 Exchange rate flexibility and distance to the productivity frontier

In this subsection, we examine whether the effect of exchange rate flexibility on growth depends on another measure of development, namely the level of technological development measured by labor productivity. The empirical strategy is similar to the one previously followed to assess the role of financial development. The impact of exchange rate volatility and of labor productivity are first analyzed in a linear set-up before being interacted in order to uncover any non-linear effects. Formally, the distance to the technology frontier can be expressed as:

$$d_{i,t} = \ln(y_{i,t}/l_{i,t}) - \ln(y_{us,t}/l_{u,t})$$

where $y_{i,t}$ and $l_{i,t}$ are respectively the initial level of output and the labor force at the inception of each five year period. As our regressions include a common time effect, we can simply ignore the term $\ln(y_{us,t}/l_{u,t})$ and measure the distance to the frontier with the absolute level of labor productivity, $\ln(y_{i,t}/l_{i,t})$.

As we are using the same baseline specification, the regressions without interacted terms are identical to the ones presented in columns 1 and 3 of Tables 1, 2, and 3. Notice that in the pure linear specification, the coefficient on initial output per worker, i.e. the convergence term, is negative but not significant except in the regression using real exchange rate volatility. Table 4 presents the results of regressions performed using the flexibility of exchange rate regime, real exchange rate volatility and real overvaluation.

Regression [4.1] shows that the interaction between labor productivity and the exchange rate regime has a positive and significant impact on growth. The interpretation is that the higher the level of productivity, the better (or the less detrimental) is the impact of a more flexible exchange rate regime on productivity growth. We can identify a threshold level of output per worker above (below) which a more flexible (rigid) regime fosters productivity growth. The point estimate of this threshold is US$ 5000 (constant 1995 US$), which is close to the actual productivity levels of present day Thailand and Peru and to the levels of Korea and Chile in the seventies.

Regressions [4.2] and [4.3] reveal a similar non-linear effect when exchange rate volatility and real overvaluation are considered. A higher initial level of productivity dampens the negative impact of exchange rate volatility or overvaluation on productivity growth. A threshold analysis suggests that, in economies close enough to the technological frontier [i.e. with $y_{i,t}/l_{i,t} > \$30000$, the level of Spain in 1985], exchange rate volatility or real overvaluation has a positive impact on the productivity growth process.

3.4 Term-of-trade growth and exchange rate flexibility

It is often argued that a flexible exchange rate regime is desirable since it can stabilize the effects of real shocks. Recently, Broda (2004) and Edwards and Levy-Yeyati (2005) have found empirically that flexible exchange rate regimes tend to absorb the effects of term of trade shocks. However, this result does not necessarily imply that exchange rate flexibility has a positive impact on growth. We examine this issue by including terms-of-trade growth in our previous regressions and present the results in Table 5. In the baseline regression [5.1], a 10% deterioration in terms of trade leads to a reduction of 0.8% in productivity growth. In regression [5.2], we find that the impact on productivity growth of a term of trade shock depends crucially on the nature of the exchange rate regime. It is larger under a fixed exchange rate regime and close to zero under a floating regime. This result confirms the stabilizing role of flexible exchange rates. However, in regression [5.3], we show that this stabilization effect fully coexists with the growth enhancing effect of a more fixed regime. Thus, the empirical evidence shows that even though exchange rate flexibility dampens the impact of terms-of-trade shocks, it has a negative impact on growth for less financially developed countries.

3.5 Robustness tests

The set of regressions presented in Tables 1 to 5 offers solid evidence that the level of financial or technology development plays an important role in mitigating the negative effects of exchange rate volatility on productivity growth. It is also reassuring that control variables in the regressions have the expected effects: education and trade openness have a positive and often significant impact on growth while the effect of inflation and government burden is negative although not always statistically significant. Moreover, the results stay unchanged when the effects of crises are accounted for.

In this subsection, we discuss further evidence on the robustness of our main empirical findings. To save space, we focus on the impact of the interaction between exchange rate regimes and financial development (table 1) and on the impact of the interaction between real effective exchange rate volatility and financial development. We examine whether the results are robust to different time periods, alternative exchange rate classifications, different measures of financial development and the omission of subgroups of countries. The main results corresponding to this discussion are presented on tables A1 to A7.

Different Time Windows

Using time effects in all our regressions, we control for any common factor that could affect all countries in any five year interval. Moreover, our non-linear specification implicitly allows for time and cross-country variation in the effect of the flexibility of the exchange rate regime on productivity growth. However, we would like to check if our results hold when different time windows are used for the estimation. A sensitive issue is whether we should use any information from the period prior to the collapse of the Bretton-Woods system (1973). Our baseline time span is 1960-2000, but the early observations are used as internal instruments so that the first observation in levels that is actually considered in the estimation belongs to the 1970-1975 interval and the first observation in difference is taken between the 1970-1975 and the 1965-1970 intervals. In Table A1, we are more restrictive and consider the information available only for the period 1970-2000 and in the period 1975-2000. In both cases, our main result holds and the interaction coefficient is higher indicating a stronger dependence of the effect of the flexibility of the exchange regime on the level of financial development. We also consider three successive periods of 20 years: 1960-1980; 1970-1990; 1980-2000. Our result holds significantly in the last two periods but not in the first which suggests that our finding is actually stronger when we restrict our regression analysis to the post Bretton-Woods era. Performing the same robustness test on the effect of the interaction between financial development and real exchange rate volatility yields the same conclusions. As shown in Table A2, the interaction effect is stronger when the information available is restricted to 1970-2000.

Measures of exchange rate flexibility

We have already examined the impact of three substantially different measures of exchange rate flexibility and obtained very similar results. However, it is useful to examine the results with other exchange rate classifications. Table A3 presents the robustness test to five alternative exchange rate classifications. In four out of five cases, our main result holds. The alternative de facto "consensus" classification of Gosh et al. (2003) give similar results. Our result is also confirmed when the degree of exchange rate flexibility is measured on a more detailed scale using Reinhart's and Rogoff's coarse classification. We notice that the implicit threshold above which a flexible exchange rate regime is growth enhancing is almost identical for the gross and coarse Reinhart and Rogoff classifications.[27] In contrast, when the classification of Levy-Yeyati and Sturzenegger (2003) is used, the interaction with the level of financial development becomes negative but insignificant. In order do understand the differences between the results obtained with the classification of Reinhart and Rogoff and the ones obtained with the classifcation of Levy-Yeyati and Sturzenegger, we modify the later in the following way: first, we eliminate the observations classified as free-falling by Reinhart and Rogoff; second, we reclassify the observations with a dual exchange rate according to Reinhart's and Rogoff's classification. We obtain a classification that combines the clustering approach of Levy-Yeyati with the main inovations of Reinhart's and Rogoff's approach. Interestingly, when this modified classification is used in the baseline regression, our main finding is confirmed.[28]

Measures of financial development

Table A4 shows the robustness of our main result to the use of alternative measures of financial development. Our initial and preferred measure is private credit to GDP from banks and other financial institutions. Our main result still holds when we consider the other side of the financial sector balance sheet (liquid liabilities over GDP) or when we restrict ourselves to a measure of the degree of financial intermediation provided by deposit money banks (deposit money banks assets over GDP).

Omission of continents

Table A5 and Table A6 show that our main result remains stable and significant when sub-groups of countries are omitted in a systematic way. Our sample is partioned into seven "continents" according to the World Bank classification. Then, the two baseline regressions (Regression [2], Table 1

[27] 55% vs 59% when the gross classification over 1970-2000 is considered (Table A1, col 1)

[28] In that case, the point estimate of the interaction term is slightly higher than the point estimate of the interaction term in the regression using the classification of Reinhart and Rogoff on the same sample period (0.68 vs. 0.43).

and Regression [2], Table 2) are repeated with the omission of one continent at a time. The interaction term between exchange rate flexibility or volatility and financial development remains positive and significant at 10 percent confidence level in thirteen out of fourteen regresssions.[29] Moreover its point estimate is also stable and varies within a one standard error band around the corresponding benchmark point estimate.

Crises and regime switching

A typical scenario of a currency crisis is a period of fixed exchange rate with growth that is followed, after a large devaluation, by a more flexible exchange rate and a depressed economy (e.g., the Asian, Mexican and Southern Cone crises). To determine whether this is not the driving force behind our results, we made various tests. First, we introduced a crisis dummy in Tables 2 to 5 and showed that this does not affect significantly our results. Second, we ran the regression with the subset of countries that had no regime switching and still found a significant coefficient on the interaction between financial development and exchange rate flexibility. Third, we identified the cases in our sample where a switch from fixed to float was associated with a large decline in growth. We only found 6 episodes with a growth decline larger than 5%. Removing them from the sample does not affect our results.[30]

Endogeneity issues

To be completed

Exchange rate flexibility and market regulation

While financial development conditions how firms can react to exchange rate shocks, the general business environment may also play a role. Thus, we also tested whether a more regulated business environment makes a country more sensitive to exchange rate fluctuations. We use the regulation indices constructed by Loayza, Oviedo and Serven (2004) from various sources including the "Doing Business Survey" (The WorldBank Group). Here we consider 4 indices: labor regulation, product regulation, regulation of entry and bankruptcy regulation (or regulation of closure). We also include an overall index of regulation. Regulation indices are normalized between zero and one with a higher value standing for higher levels of regulation.

[29] This result is specially noticeable considering that Windmejier correction for small sample is used in the estimation.

[30] These episodes are Chile & Ecuador (81-82), Indonesia & Thailand (97-98), Ghana (73-74), Jamaica (90-91). The other episodes, such as Argentina in the early eighties, are in the freeling falling category in RR and are not considered in our sample in Table 2.

The results are shown in Table A7. They show that the interaction between regulation and the degree of flexibility of the exchange rate regime is in all cases negative. It is significant, at the 5% level, in the case of production and closure but not in the case of entry or labor.[31]

4 Conclusion

The vast empirical literature following Baxter-Stockman (1989) and Flood-Rose (1994) generally finds no detectable difference in macroeconomic performance across fixed versus floating exchange rate regimes. In this paper, we argue that instead of just looking at macroeconomic volatility, it is also important to look for the effects of the exchange rate regime on growth. We develop a theoretical model in which higher levels of exchange rate volatility can stunt growth, especially in countries with thin capital markets. We offer what seems to be fairly robust evidence suggesting the importance of the financial development for how the choice of exchange rate regime affects growth.[32] Indeed, at this point, the main qualification to our results would seem to be the standard question of endogeneity. Whereas it is indeed difficult to find satisfactory instruments, we note that we obtain similar results for various measures of exchange rate volatility, as well as when we look at measures of distance from frontier and degree of market regulation in place of the level of financial development. Also, by excluding high inflation "freely falling" exchange rate regimes in our baseline regressions, we are hopefully eliminating the most egregious cases where weak institutions would simultaneously explain low productivity growth and the choice of exchange rate

[31] An important caveat is that, in contrast to the other variables, the regulation indices are constructed from various surveys performed in the nineties and do not exhibit time variation. Therefore, we can identify and test the effect of the interaction between regulation indices and the flexibility of the exchange rate but not their individual effect on productivity growth. More precisely, the regulation index, along with any fixed effect, drops out when equations are taken in differences. The number of observations is also smaller.

[32] Rogoff et. al (2004) and Husain, Mody and Rogoff (2005) do find differences in exchange rate regime performance across developing countries, emerging markets and advanced economies. However, perhaps because they do not incorporate any structural variables in their regressions such a private credit to GDP, or distance to frontier, they only found significant and robust effects of exchange rate regime choice on growth in advanced economies.

regime (generally flexible because high inflation makes a sustained fix impossible.)

Are our result necessarily at odds with the prescriptions of the standard exchange rate models? Not necessarily. The classical literature holds that the greater the volatility of real shocks relative to financial shocks a country faces, the more flexibility is should allow in its exchange rate. Our analysis shows that this prescription has to be modified to allow for the fact that financial market shocks are amplified in developing countries with thin and poorly developed credit markets. In particular, countries should adopt more flexible exchange rates the greater the effective volatility of real shocks relative to the effective volatility of financial market shocks. Clearly, more fully articulated structural models are needed to properly measure the tradeoffs, and this would appear to be an important challenge for future research.

References

[1] Aghion, Ph., G.M. Angeletos, A. Banerjee, and K. Manova (2005), "Volatility and Growth: Financial Development and the Cyclical Behavior of the Composition of Investment," mimeo.

[2] Aghion, Ph., Ph. Bacchetta, and A. Banerjee (2004), "A Corporate Balance-Sheet Approach to Currency Crises," *Journal of Economic Theory* 119, 6-30.

[3] Aghion, Ph., P. Howitt, and D. Mayer-Foulkes (2005), "The Effect of Financial Development on Convergence: Theory and Evidence," *Quarterly Journal of Economics* 120(1), 173-222.

[4] Arellano M. and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 58, 277-297.

[5] Arellano M. and O. Bover (1995), "Another Look at the Instrumental-Variable Estimation of Error-Components Models," *Journal of Econometrics*, 68, 29-51.

[6] Bacchetta, Philippe and van Wincoop, Eric (2000), "Does Exchange Rate Stability Increase Trade and Welfare?," *American Economic Review* 90, 1093-1109.

[7] Bacchetta, Philippe and Eric van Wincoop (2006), "Can Information Heterogeneity Explain the Exchange Rate Determination Puzzle?," *American Economic Review*, forthcoming.

[8] Baldwin, Richard (1989) "Growth Effects of 1992," *Economic Policy*, 9, 247-282.

[9] Blundell R, and S. Bond (1998), "Initial conditions and Moment Conditions in Dynamic Panel Data Models," *Journal of Econometrics*, 87, 115-143.

[10] Bond, S. (2002), "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice," cemmap working paper no. 09/02.

[11] Broda, Christian (2004), "Terms of Trade and Exchange Rate Regimes in Developing Countries," *Journal of International Economics* 63, 31-58.

[12] Calvo, G.A. and C. M. Reinhart (2002), "Fear of Floating," *Quarterly Journal of Economics* 117, 379-408.

[13] Clark, P., N. Tamirisa, and Shang-Jin Wei (2004), "A New Look at Exchange Rate Volatility and Trade Flows," IMF Occasional Paper No. 235.

[14] De Grauwe, P. and G. Schnabl (2005), "Exchange Rate Stability, Inflation and Growth in (South) Eastern and Central Europe," mimeo.

[15] Devereux, M.B. and P.R. Lane (2003), "Understanding Bilateral Exchange Rate Volatility," *Journal of International Economics* 60, 109-132.

[16] Dollar D. (1992), "Outward Oriented Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985," *Economic Development and Cultural Change, 9*40-3, 523-544.

[17] Duarte, M. and A.C. Stockman (2005), "Rational Speculation and Exchange Rates," *Journal of Monetary Economics* 52, 3-29.

[18] Dubas, J.M., B.-J. Lee, and N.C. Mark (2005), "Effective Exchange Rate Classifications and Growth," NBER Working Papers 11272.

[19] Edwards, Sebastian, and Eduardo Levy Yeyati (2005), "Flexible Exchange Rates as Shock Absorbers," *European Economic Review* 49(8), 2079-2105.

[20] Engel, C. and M. Devereux (2002), "Exchange Rate Pass-Through, Exchange Rate Volatility, and Exchange Rate Disconnect," *Journal of Monetary Economics*, June 2002, 913-940.

[21] Frankel, J. and A. Rose (2002), "An Estimate of the Effect of Common Currencies on Trade and Income," *Quarterly Journal of Economics* May, 437-468.

[22] Garber, Peter M., and Lars E.O. Svensson (1995), "The Operation and Collapse of Fixed Exchange Rate Regimes" in Gene M. Grossman and Kenneth Rogoff (eds.), *The Handbook of International Economics*, vol. 3, (Amsterdam, Elsevier Press).

[23] Ghosh, A., A.M. Gulde, and H.C. Wolf (2003), *Exchange Rate Regimes: Choices and Consequences*, MIT Press.

[24] Goldfajn, I. and R.Valdes (1999), "The Aftermath of Appreciations," *Quarterly Journal of Economics* 114, 229 - 62.

[25] Hausmann, R., U. Panizza, and R. Rigobon (2004), "The Long-Run Volatility Puzzle of the Real Exchange Rate," NBER Working Paper No. 10751.

[26] Huang, H. and P. Malhotra (2004), "Exchange Rate Regimes and Economic Growth: Evidence from Developing Asian and Advanced European Economies," mimeo, IMF.

[27] Husain, A. M., A. Mody, and K.S. Rogoff (2005), "Exchange Rate Regime Durability and Performance in Developing versus Advanced Economies," *Journal of Monetary Economics* 52, 35-64.

[28] Jeanne, O. and A.K. Rose (2002), "Noise Trading and Exchange Rate Regimes," *Quarterly Journal of Economics* 117, May, 537-69.

[29] Kollman, Robert (2002), "Monetary Policy Rules in the Open Economy: Effects on Welfare and Business Cycles," *Journal of Monetary Economics* 49, 989-1015.

[30] Krugman, Paul (1987), *The Age of Diminshed Expectations*, MIT Press.

[31] Levine, R., Loayza N. and T. Beck (2000), "Financial Intermediation and Growth: Causality and Causes," *Journal of Monetary Economics*, 46(1), 31-77.

[32] Loayza, N. and R. Ranciere (2005), "Financial Development, Financial Fragility and Growth", *Journal of Money, Credit and Banking,* forthcoming

[33] Loayza N., A.M. Oviedo and L. Serven (2004), "Regulation and Macroeconomic Performance", mineo

[34] Levy-Yeyati, E. and F. Sturzenegger (2003), "To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth," *American Economic Review* 93, 1173-1193.

[35] Obstfeld, M. (2004), "Pricing-to-Market, the Interest-Rate Rule, and the Exchange Rate", mimeo.

[36] Obstfeld, Maurice and Kenneth Rogoff (1996), *Foundations of International Macroeconomics*, MIT Press.

[37] Obstfeld, Maurice and Kenneth Rogoff (2000), "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" *NBER Macroeconomics Annual* 15.

[38] Razin, A. and Y. Rubinstein (2004), "Growth Effects of the Exchange-Rate Regime and the Capital-Account Openness in A Crisis-Prone World Market: A Nuanced View," NBER WP No. 10555.

[39] Reinhart, C.M. and K.S. Rogoff (2004), "The Modern History of Exchange Rate Arrangements: A Reinterpretation," *Quarterly Journal of Economics* 119(1):1-48, February.

[40] Rogoff, Kenneth, Aasim M. Husain, Ashoka Mody, Robin J. Brooks, and Nienke Oomes (2004), "Evolution and Performance of Exchange Rates Regimes", International Monetary Fund Occasional Paper No. 229.

[41] Rose, A. (2000), "One Money, One Market: Estimating the Effect of Common Currencies on Trade," *Economic Policy* 30, 7-46.

[42] Sack, B. and V. Wieland (2000), "Interest-Rate Smoothing and Optimal Monetary Policy: A Review of Recent Empirical Evidence," *Journal of Economics and Business*, January 2000.

[43] Shambaugh, J.C. (2004), "The Effect of Fixed Exchange Rates on Monetary Policy," *Quarterly Journal of Economics* 119, 301-352.

[44] Windmeijer, F., (2004), "A finite sample correction for the variance of linear two-step GMM estimator," *Journal of Econometrics,* 126-1, 25-51

[45] Woodford, M. (2003), *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press.

A Construction of the Real Exchange Rate Measures

A.1 Effective Real Exchange Rate

We construct a trade-weighted effective exchange rate measure deflated using labor costs, using the same time invariant trade weights as in Goldfajn and Valdes (1999): trade shares with major trade partners in 1985 from United Nation Trade Statistics.[33] As reliable data on labor costs are available only for a small subset of countries, we use the relative price level of consumption from international comparison of prices in Penn World Tables 6.1 in order to obtain real exchange rate values. The formula for the effective real exchange rate is:

$$RER_i^{SH} = \prod_{j=1}^{J} (P_i/S_{ij}P_j)^{w_{i,j}}$$

where $i \in [1, 99]$ and $j \in [1, 14]$ index the country and its trade partners, P_i and P_j are the prices of the same basket of consumption goods in domestic currency in country i and country j, S_{ij}, the nominal exchange rate, i.e., the number of units of currency i for a unit of currency j, and w_{ij} the weight of country j in the trade exchange of country i.

An alternative measure of the effective real exchange rate is constructed using monthly CPI data from International Finance Statistics and monthly nominal exchange rate. As CPI is an index series normalized at 100 in 2000 for every countries, we obtained an *index* of real exchange rate:

$$RER_i^{cpi} = \prod_{j=1}^{J} (I_i^{cpi}/S_{ij}I_j^{cpi})^{w_{i,j}}$$

where I_i^{cpi} is the CPI index.

A.2 Real Exchange Rate Volatility.

The volatility of the real exchange rate used in the regression analysis is computed in each five year interval as the annual standard deviation of the

[33] see Appendix B for the list of major trade partners.

growth rate of the effective real exchange rate:[34]

$$\sigma_{i,t,t+5} = stdev[\ln(RER_{it}^{SH}) - \ln(RER_{it-1}^{SH})]$$

A.3 Real Overvaluation

In order to construct a measure of real exchange rate overvaluation, we follow Dollar (1992). The equilibrium concept for the real exchange rate is Purchasing Power Parity adjusted from differences in the relative price of non tradeables to tradeables attributed to differences in factor endowments (i.e. the "Balassa-Samuelson" effect). Following Dollar (1992), we perform the following pooled OLS regression where income per capita and geographical dummies are used as proxies for factor endowments:

$$\ln(RER_{i,t}^{SH}) = \alpha + \beta_t d_t + \gamma \ln(Y_{it}) + \delta lac + \eta afri + \varepsilon_{i,t} \tag{15}$$

where d_t is a time dummy, Y_{it} GDP per capita, lac and $afri$ continental dummies for Latin-American and African countries. Therefore, the real overvaluation measure is defined as:

$$ROVI_{i,t} = 100 \times [((RER_{i,t}^{SH}) - \widehat{RER_{i,t}^{SH}})]$$

where $\widehat{RER_{i,t}^{SH}}$ is obtained by taking the antilog of the predicted series in regression (15).[35]

An alternative measure of Real Overvaluation is derived following Goldfajn-Valdes (1999) as the log deviation of the CPI based measure of real exchange rate, RER_i^{CPI} from a stochastic trend constructed using a Hodrick-Prescott filter with a smoothing parameter $\lambda = 10^8$.

[34] Using growth rates to control for trending behavior in real exchange rate is standard in the literature (e.g. Hussain, Mody and Rogoff (2005))

[35] The estimation of equation (15) yields

	coef	
$\widehat{\gamma}$	0.234***	
$\widehat{\delta}$	-0.139***	*** denotes 1% significance
$\widehat{\eta}$	-0.081***	
R^2	0.27	

Figure 1: Real Exchange Rate Volatility, Exchange Rate Flexibility and Productivity Growth

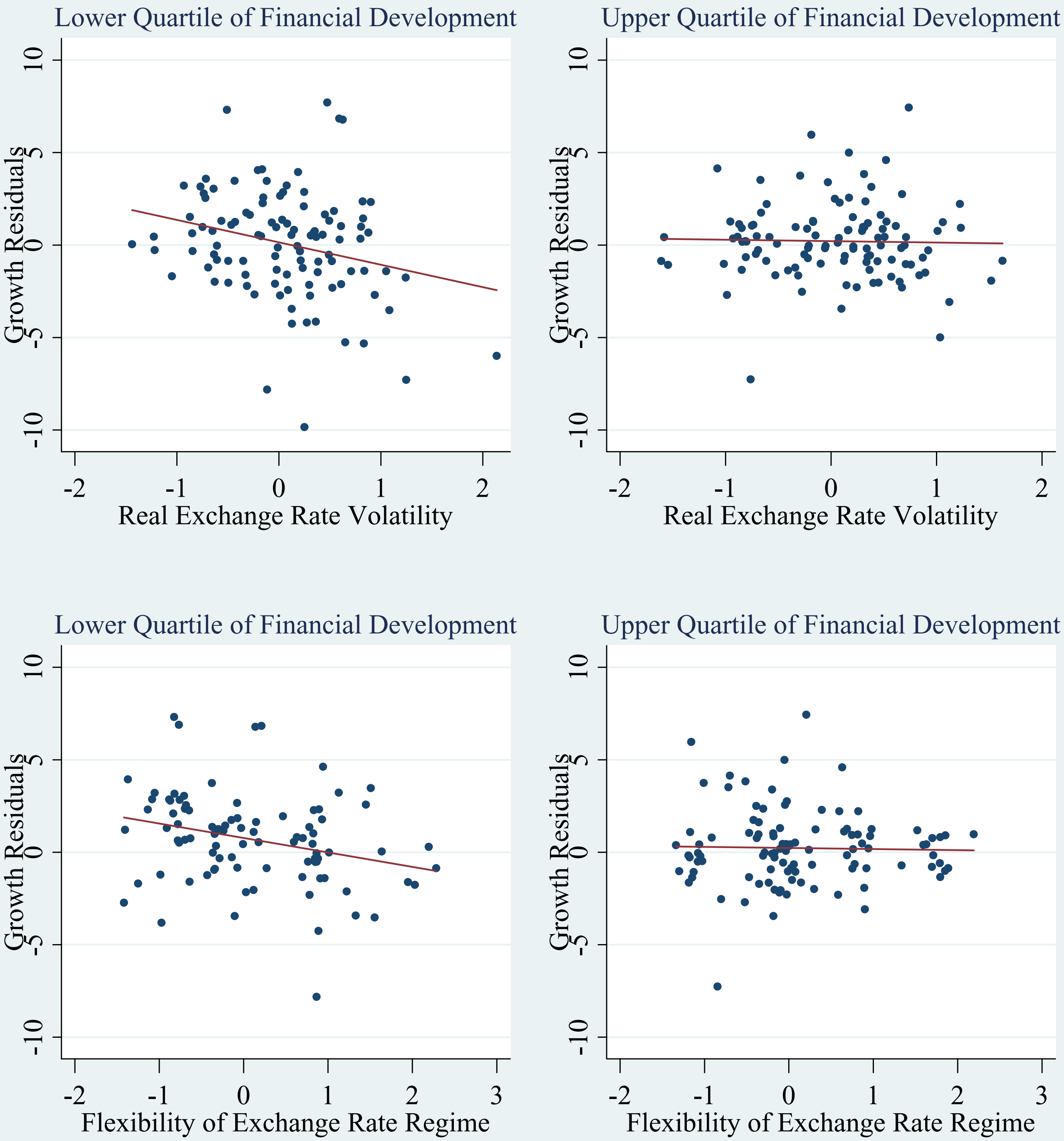

Table 1
Growth effects of the flexibility of exchange rate regime: the role of financial development
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000			
Unit of observation:	Non-overlapping 5-year averages			
Estimation Technique:	System GMM			
	[2.1]	[2.2]	[2.3]	[2.4]
Degree of the Exchange Flexibility	-0.191	-1.135 *	-0.1442	-1.2266 **
(Reinhart and Rogoff Clasisification)	*0.349*	*0.579*	*0.2880*	*0.5629*
Financial Development	0.684 **	0.185	0.655 **	0.258
(private domestic credit/GDP, in logs)	*0.347*	*0.160*	*0.326*	*0.941*
Initial Output per Worker	-0.150	-0.117	-0.152	-0.126
(log(Initial Output per Worker))	*0.418*	*0.447*	*0.447*	*0.461*
Flexibility * Financial Development		0.303 **		0.336 **
		0.146		*0.159*
Control Variables:				
Education	1.493 **	1.518 **	1.481 **	1.509 **
(secondary enrollment, in logs)	*0.630*	*0.676*	*0.574*	*0.605*
Trade Openness	1.632 *	1.626 *	1.719 **	1.407 *
(structure-adjusted trade volume/GDP, in logs)	*0.914*	*0.858*	*0.869*	*0.799*
Government Burden	-1.842 *	-1.950 *	-1.917 *	-1.989 *
(government consumption/GDP, in logs)	*1.088*	*1.136*	*1.114*	*1.150*
Lack of Price Stability	-2.731	-2.767	-1.660	-2.470
(inflation rate, in log [100+inf. rate])	*1.757*	*1.761*	*2.088*	*1.850*
Crisis			-1.826 *	-1.741 *
(0-1 dummy for banking or currency crisis)			*1.054*	*1.075*
Intercept	15.711 **	17.418 **	10.940	15.731 *
	7.5131	*8.509*	*9.4513*	*9.2799*
No. Countries / No. Observations	79/497	79/497	79/497	79/497
SPECIFICATION TESTS (P-Values)				
(a) Sargan Test:	0.252	0.227	0.291	0.367
(b) Serial Correlation :				
First-Order	0.000	0.000	0.000	0.000
Second-Order	0.348	0.361	0.441	0.388
WALD TESTS (P-values)				
Ho :Exchange Rate Flexibility Total Effect		0.009		0.000
Ho :Financial Development Total Effect =0		0.035		0.044

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

THRESHOLD ANALYSIS				
Growth enhancing effect of exchange rate flexibility:				
Private Credit /GDP greater than:		0.42		0.38
s.e.		*0.19*		*0.17*

Table 2
Growth effects of real effective exchange rate volatility: the role of financial development
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000			
Unit of observation:	Non-overlapping 5-year averages			
Estimation Technique:	System GMM			
	[3.1]	[3.2]	[3.3]	[3.4]
Real Exchange Rate Volatility	-0.637 **	-3.124 **	-0.554 **	-3.319 **
	0.273	*1.204*	*0.262*	*1.208*
Financial Development	1.111 **	-0.650	0.987 **	-0.729
(private domestic credit/GDP, in logs)	*0.455*	*0.808*	*0.402*	*0.821*
Initial Output per Worker	-1.112 **	-0.530	-1.025 **	-0.828 **
(log(Initial Output per Worker))	*0.391*	*0.474*	*0.360*	*0.404*
Exchange Rate Volatility * Financial Development		0.677 **		0.706 **
		0.262		*0.277*
Control Variables:				
Education	1.807 **	1.778 **	1.976 **	2.378 **
(secondary enrollment, in logs)	*0.532*	*0.694*	*0.465*	*0.585*
Trade Openness				
(structure-adjusted trade volume/GDP, in logs)	1.053 *	1.115 **	1.420 **	1.579 *
	.5722	*.7693*	*.5693*	*0.9748*
Government Burden	-0.416	-0.928	-1.068	-0.871
(government consumption/GDP, in logs)	*1.153*	*1.070*	*1.104*	*1.372*
Lack of Price Stability	-2.569 *	-1.961	-1.872 *	-1.172
(inflation rate, in log [100+inf. rate])	*1.487*	*1.237*	*1.117*	*1.379*
Crisis			-2.250 **	-2.857 **
(banking or currency crisis)			*0.878*	*1.374*
Intercept	18.325 **	13.346 **	15.689 **	14.556 **
	7.043	*5.072*	*5.848*	*6.971*
No. Countries / No. Observations	83/548	83/548	83/548	83/548
SPECIFICATION TESTS (P-Values)				
(a) Sargan Test:	0.461	0.241	0.663	0.187
(b) Serial Correlation :				
First-Order	0.000	0.000	0.000	0.000
Second-Order	0.462	0.383	0.572	0.516
WALD TESTS (P-values)				
Ho :Exchange Rate Flexibility Total Effect=0		0.000		0.000
Ho :Financial Development Total Effect =0		0.032		0.012

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

THRESHOLD ANALYSIS				
Growth enhancing effect of exchange rate flexibility if:				
Private Credit /GDP greater than:		1.01		1.10
s.e		*0.34*		*0.39*

Table 3
Growth effects of effective exchange rate real overvaluation: the role of financial development
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effec
(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000			
Unit of observation:	Non-overlapping 5-year averages			
Estimation Technique:	System GMM			
	[4.1]	[4.2]	[4.3]	[4.4]
Degree of the Real Exchange Rate Overvaluation	-0.9949 **	-1.1618 *	-1.1760 **	-1.1787 **
(log deviation from equilibrium exchange rate)	*0.5038*	*0.7108*	*0.5339*	*0.6590*
Financial Development	0.6361 *	-0.1007	0.5948 *	-0.0404
(private domestic credit/GDP, in logs)	*0.3446*	*2.5091*	*0.3296*	*2.1631*
Initial Output per Worker	-0.0384	-0.3604	-0.0574	-0.3545
(log(Initial Output per Worker))	*0.3815*	*0.5308*	*0.3690*	*0.5181*
Real overvaluation * Financial Development		0.2053 **		0.1629 **
		0.0769		*0.0818*
Control Variables:				
Education	1.1854 *	1.5315 **	1.2454 **	1.6449 **
(secondary enrollment, in logs)	*0.6131*	*0.7724*	*0.5952*	*0.8002*
Trade Openness	1.3277 **	1.6194 **	1.4615 *	1.6297 **
(structure-adjusted trade volume/GDP, in logs)	*0.6264*	*0.6876*	*0.8116*	*0.7773*
Government Burden	-1.4566 *	-2.1841	-1.3286	-1.9306
(government consumption/GDP, in logs)	*0.8274*	*1.3576*	*0.8749*	*1.4829*
Lack of Price Stability	-4.5052 **	-3.8190 **	-3.8574 **	-3.7077 **
(inflation rate, in log [100+inf. rate])	*1.0087*	*1.1602*	*0.9345*	*0.8811*
Crisis			-1.2813	-2.0817
(banking or currency crisis)			*1.3257*	*1.2843*
Intercept	27.6120 **	27.5510 **	25.1475 **	26.8815 **
	5.7204	*8.7510*	*5.5564*	*7.6262*
No. Countries / No. Observations	83/548	83/548	83/548	83/548
SPECIFICATION TESTS (P-Values)				
(a) Sargan Test:	0.413	0.224	0.279	0.220
(b) Serial Correlation :				
First-Order	0.000	0.000	0.000	0.000
Second-Order	0.268	0.278	0.359	0.271
WALD TESTS (P-values)				
Ho :Exchange Rate Flexibility Total Effect=0		0.000		0.000
Ho :Financial Development Total Effect =0		0.037		0.028

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

THRESHOLD ANALYSIS				
Growth enhancing effect overvaluation:				
Private Credit /GDP greater than:		1.63		1.28
s.e.		*0.65*		*0.48*

Table 4

Growth effects of the flexibility of exchange rate regime, real exchange rate volatility and real overvaluation: the role of distance to the technological frontier

Dependent Variable: Growth Rate of Output per Worker

Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Ef

(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000		
Unit of observation:	Non-overlapping 5-year averages		
Estimation Technique:	System GMM		
	[5.1]	[5.2]	[5.3]
Degree of the Exchange Flexibility	-4.845 **		
(Reinhart and Rogoff Clasisification)	*2.287*		
Real Exchange Rate Volatility		-3.361 *	
		1.797	
Degree of the Real Exchange Rate Overvaluation			-3.886 **
(log deviation from equilibrium exchange rate)			*1.308*
Financial Development	0.640 **	1.180 **	0.593 *
(private domestic credit/GDP, in logs)	*0.315*	*0.504*	*0.305*
Initial Output per Worker	-1.474 **	-1.830 **	-3.074
(log(Initial Output per Worker))	*0.641*	*0.595*	*2.126*
Flexibility*Initial Ouput Per Worker	0.568 **		
	0.265		
Exchange Rate Volatility*Initial Ouput Per Worker		0.358 **	
		0.173	
Real overvaluation*Initial Ouput Per Worker			0.401 **
			0.180
Control Variables:			
Education	1.505 **	2.470 **	1.518 **
(secondary enrollment, in logs)	*0.703*	*0.567*	*0.678*
Trade Openness	1.003	1.137	1.212 *
(structure-adjusted trade volume/GDP, in logs)	*0.718*	*1.1022*	*0.706*
Government Burden	-0.952	-0.795	-1.327
(government consumption/GDP, in logs)	*1.419*	*1.261*	*0.988*
Lack of Price Stability	-4.006 **	-2.034	-3.801 **
(inflation rate, in log [100+inf. rate])	*0.981*	*1.347*	*0.945*
Crisis	-1.889 *	-2.623 **	-1.908 *
(0-1 dummy for banking or currency crisis)	*1.064*	*1.184*	*1.050*
Intercept	30.217 **	20.266 **	46.119 **
	6.837	*7.668*	*16.205*
No. Countries / No. Observations	79/497	83/548	83/548
SPECIFICATION TESTS (P-Values)			
(a) Sargan Test:	0.595	0.180	0.423
(b) Serial Correlation :			
First-Order	0.000	0.000	0.000
Second-Order	0.364	0.417	0.312
WALD TESTS (P-values)			
Ho :Exchange Rate Measure Total Effect=0	0.000	0.017	0.000
Ho :Initial Output Total Effect =0	0.014	0.000	0.000

** means significant at 5% and * means significant at 10%

Source: Authors' estimations

THRESHOLD ANALYSIS			
Growth enhancing effect of each exchange rate measure:			
Ouput Per Worker greater than (1995 US$)	5099	12063.4	16047
s.e.	*2321*	*5329*	*6477*

Table 5
Growth effects of the flexibility of exchange rate regime and term of trade growth
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000		
Unit of observation:	Non-overlapping 5-year averages		
Estimation Technique:	System GMM		
	[6.1]	[6.2]	[6.3]
Term of Trade Growth	0.083 *	0.327 *	0.385 **
(Growth Rate of Term of Trade Index)	*0.049*	*0.169*	*0.173*
Degree of the Exchange Flexibility			-0.126
(Reinhart and Rogoff classification)			*0.350*
Financial Development	0.572 *	0.783 *	0.285
(private domestic credit/GDP, in logs)	*0.322*	*0.395*	*0.192*
Initial Output per Worker	-0.887 *	-0.644 *	-0.702
(log(Initial Output per Worker))	*0.531*	*0.381*	*0.465*
Flexibility*Term of Trade Growth		-0.107 **	-0.136 **
		0.044	*0.062*
Flexibility*Financial Development			0.357 **
			0.159
Control Variables:			
Education	2.045 **	2.301 **	2.301 **
(secondary enrollment, in logs)	*0.542*	*0.467*	*0.571*
Trade Openness	0.980	1.493	1.385 *
(structure-adjusted trade volume/GDP, in logs)	*0.746*	*1.074*	*0.706*
Government Burden	-1.033	-0.762	-0.707
(government consumption/GDP, in logs)	*0.738*	*1.191*	*0.982*
Lack of Price Stability	-3.349 **	-4.354 **	-3.560 **
(inflation rate, in log [100+inf. rate])	*1.189*	*1.784*	*1.432*
Crisis	-2.043 *	-2.104 *	-1.999 *
(0-1 dummy for banking or currency crisis)	*1.054*	*1.065*	*1.050*
Intercept	20.222 **	32.117 **	35.334 **
	4.044	*10.706*	*9.815*
No. Countries / No. Observations	83/548	83/548	79/494
SPECIFICATION TESTS (P-Values)			
(a) Sargan Test:	0.130	0.420	0.680
(b) Serial Correlation :			
First-Order	0.000	0.000	0.000
Second-Order	0.400	0.450	0.450

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

Table A 1: Growth effects of the flexibility of exchange rate regime
Robustness: Different Time Windows
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1970-2000	1975-2000	1960-1980	1970-1990	1980-2000
Unit of observation:	Non-overlapping 5-year averages				
Estimation Technique:	System GMM				
	[1]	[2]	[3]	[4]	[5]
Degree of the Exchange Flexibility	-1.742 **	-3.090 **	-1.189	-2.381 *	-3.366 **
(Reinhart and Rogoff Clasisification)	*0.745*	*1.453*	*2.010*	*1.126*	*1.540*
Financial Development	-0.800	-2.055	0.080	-2.040	-2.110
(private domestic credit/GDP, in logs)	*0.666*	*1.455*	*0.126*	*1.280*	*1.550*
Initial Output per Worker	0.132	0.102	0.002	0.240	0.698
(log(Initial Output per Worker))	*0.378*	*0.540*	*0.371*	*0.480*	*0.540*
Flexibility * Financial Development	**0.428** **	**0.751** **	**0.330**	**0.493** *	**0.749** **
	0.229	***0.321***	***0.340***	***0.274***	***0.353***
No. Countries / No. Observations	79/421	79/352	78/273	78/275	79/282
SPECIFICATION TESTS (P-Values)					
(a) Sargan Test:	0.596	0.269	0.279	0.162	0.155
(b) Second Order Serial Correlation :	0.125	0.619	0.153	0.269	0.47

** means significant at 5% and * means significant at 10%

Table A 2: Growth effects of the real effective exchange rate volatility
Robustness: Different Time Windows
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1970-2000	1975-2000	1960-1980	1970-1990	1980-2000
Unit of observation:	Non-overlapping 5-year averages				
Estimation Technique:	System GMM				
	[1]	[2]	[3]	[4]	[5]
Real Exchange Rate Volatility	-4.002 **	-4.493 **	-3.561	-5.231 **	-3.934 **
	0.464	*1.587*	*2.720*	*1.630*	*1.326*
Financial Development	-1.747	-2.566 *	-1.064	-3.325 **	-2.501 **
(private domestic credit/GDP, in logs)	*1.159*	*1.373*	*2.396*	*1.265*	*1.149*
Initial Output per Worker	-0.374	1.009 *	-0.949	0.486	0.928
(log(Initial Output per Worker))	*0.474*	*0.606*	*0.855*	*0.522*	*0.664*
Exchange Rate Volatility * Financial Development	**1.030** **	**1.077** **	**0.716**	**1.249** **	**0.939** **
	0.464	***0.464***	***0.464***	***0.412***	***0.401***
No. Countries / No. Observations	83/475	83/398	83/307	83/318	83/319
SPECIFICATION TESTS (P-Values)					
(a) Sargan Test:	0.14	0.11	0.22	0.41	0.10
(b) Second Order Serial Correlation :	0.17	0.66	0.96	0.72	0.61

** means significant at 5% and * means significant at 10%

Note: The specification of the regression is identical to regression 3, Table 1. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Table A 3: Growth effects of the flexibility of exchange rate regime
Robustness: Different Exchange Rate Regime Classifications
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1970-2000	1970-2000	1970-2000	1970-2000
Unit of observation:	Non-overlapping 5-year averages			
Estimation Technique:	System GMM			
Exchange Rate Classification	De Facto (RR Coarse)	De Facto (Gosh and al.)	De Facto (Initial Levy-Leyati and al.)	De Facto (Modified Levy Leyati and al.)
Degree of the Exchange Flexibility	-0.863 **	-2.280 **	1.628	-2.795 **
	0.390	*0.954*	*1.660*	*1.207*
Financial Development	-1.270	-0.740	-0.462	-1.017
	0.963	*0.990*	*0.500*	*1.100*
Initial Output per Worker	-0.085	-0.180	-0.391	-1.076 *
(log(Initial Output per Worker))	*0.430*	*0.489*	*0.630*	*0.639*
Flexibility * Financial Development	**0.215** **	**0.830** **	**-0.462**	**0.688** **
	0.080	***0.435***	***0.501***	***0.335***
No. Countries / No. Observations	79/421	79/401	79/418	79/388
SPECIFICATION TESTS (P-Values)				
(a) Sargan Test:	0.24	0.585	0.31	0.35
(b) Second Order Serial Correlation :	0.565	0.114	0.59	0.41

** means significant at 5% and * means significant at 10%

Note: The specification of the regression is identical to regression 3, Table 1. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Exchange Rate Flexibility Annual Coding:
De Facto (RR Coarse) : 13 ways Reinhart and Rogoff Coarse Classification (1: Fix to 13: Float)
De Facto (Gosh and al.): 3 ways Consensus Classification 1=Fix and Peg Regime , 2 = Intermediated Regime, 3 = Floating Regime
De Facto (Levy-Yeyati and al.): 4 ways Classification coded as (1: Fix; 2: Peg ; 3 Managed Float; 4 Float)

Table A 4: Growth effects of the flexibility of exchange rate regime
Robustness: Different Measures of Financial Development
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1970-2000	1970-2000
Unit of observation:	Non-overlapping 5-year averages	
Estimation Technique:	System GMM	
Degree of the Exchange Flexibility	-1.530 **	-1.602 **
(Reinhart and Rogoff Clasisification)	*0.510*	*0.489*
Financial Development	-1.630	
(Liquid Liabilities/GDP)	*1.210*	
Financial Development		-3.510 *
(Deposit Money Banks Assets/GDP)		*1.970*
Initial Output per Worker	0.410	0.860
(log(Initial Output per Worker))	*0.489*	*0.604*
Flexibility * Financial Development	**0.670 ** **	**1.172 ***
	0.290	***0.707***
No. Countries / No. Observations	77/400	77/404
SPECIFICATION TESTS (P-Values)		
(a) Sargan Test:	0.342	0.523
(b) Second Order Serial Correlation :	0.121	0.122

** means significant at 5% and * means significant at 10%
Source: Authors' estimations
Note: The specification of the regression is identical to regression 3, Table 1. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Table A 5: Growth effects of the flexibility of exchange rate regime
Robustness: Omission of a Continent
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Continent Omitted	East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	North America	South Asia	Sub-Saharan Africa
Period:				1970-2000			
Unit of observation:				Non-overlapping 5-year averages			
Estimation Technique:				System GMM			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Degree of the Exchange Flexibility	-1.608	-1.944	-2.003	-1.931	-2.2	-2.373	-1.442
(Reinhart and Rogoff Clasisification)	[0.702]*	[1.136]*	[0.621]**	[0.959]*	[0.859]*	[0.998]*	[0.801]*
Financial Development	-0.921	-1.091	-0.907	-0.488	-0.736	-1.437	-0.73
(private domestic credit/GDP, in logs)	[0.58]	[0.836]	[0.707]	[0.635]	[0.643]	[0.668]*	[0.5]
Initial Output per Worker	-0.273	0.703	0.013	0.376	-0.509	0.668	0.351
(log(Initial Output per Worker))	[0.388]	[0.541]	[0.455]	[0.405]	[0.387]	[0.378]*	0.532
Flexibility * Financial Development	**0.43**	**0.338**	**0.253**	**0.36**	**0.461**	**0.442**	**0.293**
	[0.202]**	**[0.191]***	**[0.126]****	**[0.227]***	**[0.229]****	**[0.247]***	**[0.17]***
No. Observations	364	321	315	376	409	403	338
No. Countries	69	62	59	71	77	76	60
SPECIFICATION TESTS (P-Values)							
(a) Sargan Test:	0.61	0.65	0.7	0.53	0.46	0.46	0.66
(b) Second Order Serial Correlation :	0.11	0.08	0.24	0.64	0.18	0.11	0.24

** means significant at 5% and * means significant at 10%

Table A 6: Growth effects of the real effective exchange rate volatility
Robustness: Omission of a Continent
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Continent Omitted	East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	North America	South Asia	Sub-Saharan Africa
Period:				1970-2000			
Unit of observation:				Non-overlapping 5-year averages			
Estimation Technique:				System GMM			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Real Exchange Rate Volatility	-3.324	-4.139	-3.606	-4.484	-2.448	-5.247	-1.828
	[1.573]*	[1.884]*	[1.731]*	[1.876]*	[1.374]*	[1.691]**	[1.627]
Financial Development	-2.076	-1.475	-0.819	-1.672	-0.06	-2.543	-0.315
(private domestic credit/GDP, in logs)	[1.259]*	[1.344]	[1.296]	[1.405]	[0.897]	[1.247]**	[1.127]
Initial Output per Worker	0.092	0.599	-0.112	0.452	-0.393	-0.215	-0.417
(log(Initial Output per Worker))	[0.515]	[0.659]	[0.553]	[0.511]	[0.531]	[0.493]	[0.615]
Exchange Rate Volatility * Financial Development	**0.852**	**0.811**	**0.763**	**1.029**	**0.635**	**1.353**	**0.628**
	[0.427]**	**[0.305]****	**[0.430]***	**[0.522]****	**[0.343]***	**[0.501]****	**[0.446]**
No. Observations	412	367	349	428	463	451	380
No. Countries	72	65	62	74	81	79	65
SPECIFICATION TESTS (P-Values)							
(a) Sargan Test:	0.37	0.47	0.65	0.19	0.24	0.15	0.48
(b) Second Order Serial Correlation :	0.15	0.44	0.83	0.53	0.47	0.23	0.02

Note: The specification of the regression is identical to regression 3, Table 1. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Table A 7: Exchange Rate Regime, Regulation and Productivity Growth
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction
(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000				
Unit of observation:	Non-overlapping 5-year averages				
Estimation Technique:	System GMM				
	[7.1]	[7.2]	[7.3]	[7.4]	[7.5]
Financial Development	1.113 *	1.046 **	1.141 **	0.942	0.863 *
(private domestic credit/GDP, in logs)	*0.594*	*0.441*	*0.562*	*0.571*	*0.511*
Initial Output per Worker	-0.640	-0.461	-0.749 *	-0.556	-1.090 *
(log(Initial Output per Worker))	*0.515*	*0.374*	*0.448*	*0.651*	*0.622*
Degree of Exchange Rate Flexibility (fld)	0.966	0.426	0.230	0.134	0.838
(Reinhart and Rogoff Clasisification)	*0.930*	0.576	*0.815*	0.823	*0.512*
fld*Overall Regulation	-2.479 **				
	1.225				
fld*Labor Regulation		-1.528			
		0.912			
fld*Product Regulation			-1.577 **		
			0.668		
fld*Regulation of Entry				-1.024	
				0.867	
fld*Bankruptcy Regulation (Closure)					-2.233 **
					1.075
Control Variables:					
Education	1.033 *	1.294 **	1.299 **	1.292 *	1.916 *
(secondary enrollment, in logs)	*0.524*	*0.528*	*0.514*	*0.672*	*0.988*
Trade Openness	0.824	1.217	1.081	1.088	0.363
(structure-adjusted trade volume/GDP, in logs)	*0.990*	*0.957*	*0.935*	*1.052*	*0.904*
Government Burden	-0.855	-1.071	-0.916	-1.842	0.083
(government consumption/GDP, in logs)	*0.973*	*0.980*	*0.890*	*1.314*	*0.951*
Lack of Price Stability	-2.846 *	-3.354 **	-2.255	-2.598	-4.257 **
(inflation rate, in log [100+inf. rate])	*1.637*	*1.380*	*1.520*	*1.742*	*1.598*
Intercept	16.349 **	3.168	16.658 **	14.618 *	19.578 **
	7.788	*6.133*	*7.415*	*8.753*	*8.065*
No. Countries / No. Observations	72/546	70/530	72/546	72/546	61/460
SPECIFICATION TESTS (P-Values)					
(a) Sargan Test:	0.44	0.45	0.52	0.47	0.67
(b) Serial Correlation :					
First-Order	0	0	0	0	0
Second-Order	0.335	0.389	0.233	0.292	0.331

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

Appendix B: List of Countries

	Full 99 Countries Sample	Sample of 83 Countries Used in the Regression Analysis	Major Trade Partner	Developing Economies
Algeria	x	x		
Argentina	x	x	x	
Australia	x	x	x	
Austria	x	x		
Bahrain	x			
Bangladesh	x	x		
Belgium	x	x		
Bolivia	x	x		x
Botswana	x	x		x
Brazil	x	x	x	
Burkina Faso	x	x		x
Burundi	x			x
Cameroon	x			x
Canada	x	x		
Central African Republic	x			x
Chile	x	x		
China	x	x		
Colombia	x	x		
Congo, Dem. Rep.	x	x		x
Congo, Rep.	x	x		x
Costa Rica	x	x		x
Cote d'Ivoire	x	x		x
Denmark	x	x		
Dominican Republic	x	x		x
Ecuador	x	x		x
Egypt, Arab Rep.	x	x		
El Salvador	x	x		x
Ethiopia	x			x
Finland	x	x		
France	x	x	x	
Gabon	x			x
Gambia, The	x	x		x
Germany	x	x	x	
Ghana	x	x		x
Greece	x	x		x
Guatemala	x	x		x
Haiti	x	x		x
Honduras	x	x		x
Hong Kong, China	x			
Hungary	x			
Iceland	x	x		
India	x	x		
Indonesia	x	x		
Iran, Islamic Rep.	x	x		x
Ireland	x	x		
Israel	x	x		
Italy	x	x	x	
Jamaica	x	x		x

Japan	x	x	x	
Jordan	x	x		
Kenya	x	x		x
Korea, Rep.	x	x		
Kuwait	x			
Liberia	x			x
Madagascar	x	x		x
Malawi	x	x		x
Malaysia	x	x		
Mexico	x	x		
Morocco	x	x		
Nepal	x			x
Netherlands	x	x	x	
New Zealand	x	x		
Nicaragua	x	x		x
Niger	x	x		x
Nigeria	x	x		x
Norway	x	x		
Pakistan	x	x		
Panama	x	x		x
Papua New Guinea	x	x		x
Paraguay	x	x		x
Peru	x	x		
Philippines	x	x		
Poland	x			
Portugal	x	x		
Romania	x			
Rwanda	x			x
Saudi Arabia	x		x	
Senegal	x	x		x
Sierra Leone	x	x		x
Singapore	x	x	x	
South Africa	x	x	x	
Spain	x	x	x	
Sri Lanka	x	x		x
Sudan	x			x
Sweden	x	x		
Switzerland	x	x		
Syrian Arab Republic	x	x		
Thailand	x	x		
Togo	x	x		x
Trinidad and Tobago	x	x		x
Tunisia	x	x		x
Turkey	x	x		
Uganda	x	x		x
United Kingdom	x	x	x	
United States	x	x	x	
Uruguay	x	x		x
Venezuela, RB	x	x		
Zambia	x	x		x
Zimbabwe	x	x		x

Appendix C: Definitions and Sources of Variables Used in Regression Analysis

Variable	Definition and Construction	Source
GDP per capita	Ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US$.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
GDP per capita growth	Log difference of real GDP per capita.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
Initial GDP per capita	Initial value of ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US$.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
Output per worker	Real GDP per worker.	Summers and Heston (1991).
Output per worker growth	Log difference of real output per worker.	Authors' construction using Summers and Heston (1991).
Initial Output per worker	Initial value of Real GDP Chain per worker.	Authors' construction using Summers and Heston (1991).
Degree of exchange rate flexibility	See Section 3.1	Reinhart and Rogoff (2001).
Education	Ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to that level of education.	World Development Network (2002) and The World Bank (2002).
Private Credit	Ratio of domestic credit claims on private sector to GDP	Author's calculations using data from IFS, the publications of the Central Bank and PWD. The method of calculations is based on Beck, Demiguc-Kunt andLevine (1999).
Trade Openness	Residual of a regression of the log of the ratio of exports and imports (in 1995 US$) to GDP (in 1995 US$), on the logs of area and population, and dummies for oil exporting and for landlocked countries.	Author's calculations with data from World Development Network (2002) and The World Bank (2002).
Government Size	Ratio of government consumption to GDP.	The World Bank (2002).
CPI	Consumer price index (2000 = 100) at the end of the year.	Author's calculations using data from IFS.
Inflation rate	Annual % change in CPI.	Author's calculations using data from IFS.
Lack of Price Stability	log(100+inflation rate).	Author's calculations using data from IFS.
Real Effective Exchange Rate	See Appendix A	Author's calculations using data from IFS and UN Trade Statistics
Real Effective Exchange Rate Volatility	See Appendix A	Author's calculations with data from IFS and UN Trade Statistics
Real Exchange Rate Overvaluation	See Appendix A	Author's calculations with data from IFS and UN Trade Statistics
Crisis dummy	Number of years in which a country underwent a systemic banking or a currency crisis, as a fraction of the number of years in the corresponding period.	Author's calculations using data from Caprio and Klingebiel (1999), Kaminsky and Reinhart (1998), and Gosh, Gulde and Wolf (2000).

REGULATION INDEXES	Each index measures the intensity of the regulatory system on a scale from 0 to 1 (1 representing the heaviest regulation). In order to be able to combine all components, Loayza, Oviedo and Serven (2004) apply the following standarization formula to each one of them: $X = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}}$ higher values of X indicate heavier regulation	Loayza, Oviedo and Serven (2004).
Overall Regulation	Average score of entry, financial market, labor, trade, fiscal burden, contract enforcement and bankrupcy regulation measures.	Loayza, Oviedo and Serven (2004).
Product Market Regulation	Average score of entry, financial market, trade, contract enforcement and bankrupcy regulation measures.	Loayza, Oviedo and Serven (2004).
Labor Regulation	Combines the percentage of workers that belong to a union, the minimun mandatory conditions and the degree of hiring and firing flexibility granted.	Loayza, Oviedo and Serven (2004).
Regulation of Entry	Combines the number of legal steps required to register a new business with an indicator of the overall legal burden of registration and willingness of the government to facilitate the process and intervene minimally.	Loayza, Oviedo and Serven (2004).
Bankrupcy Regulation	Regulation measures the efficiency of bankrupcy process by combining the time and cost of insolvency, the enforcement of priority of claims, the extent to which the efficient outcome is achieved , and the degree of court involvement in the process.	Loayza, Oviedo and Serven (2004).
Period-specific Shifts	Time dummy variables.	Authors' construction.

APPENDIX D : DESCRPTIVE STATISTICS

SAMPLE ANNUAL SUMMARY STATSITICS (1960-2000)

Variable	Observations	Mean	Std. Deviation	Min	Max
Flexibility of Exchange Rate	3224	1.84	0.91	1.00	4.00
Private Credit/ GDP	3587	34.88	36.07	0.01	236.98
Ouput per Worker	3801	13277.66	18389.82	123.39	86957.22
Secondary Schooling	3974	46.83	31.91	0.82	140.10
Adjusted Openness to Trade	3377	0.00	0.57	-2.82	1.83
Rate of Inflation	3651	15.03	34.93	-49.81	553.91
Government Expenditures to GDP	3945	14.58	6.38	0.91	76.22
Dummy Banking or Currency Crisis	3403	0.09	0.29	0.00	1.00

SAMPLE ANNUAL CORRELATION (1960-2000)

	Flexibility of Exchange Rate	Private Credit/ GDP	Ouput per Worker	Secondary Schooling	Adjusted Openness to Trade	Rate of Inflation	Government Expenditures to GDP	Dummy Crisis
Flexibility of Exchange Rate	1							
Private Credit/ GDP	0.1834	1						
Ouput per Worker	0.1041	0.7378	1					
Secondary Schooling	0.1084	0.3208	0.4161	1				
Adjusted Openness to Trade	-0.0168	0.0874	-0.0715	0.1875	1			
Rate of Inflation	0.174	-0.1975	-0.1756	-0.0657	-0.1229	1		
Government Expenditures to GDP	0.0618	0.2812	0.438	0.3453	0.2383	-0.0788	1	
Dummy Banking or Currency Crisis	0.0931	0.0649	-0.0723	0.0681	0.0644	0.0797	-0.0461	1

Average Monthly Volatility of Real Effective Exchange Rate by Exchange Rate Regime*

regime	full sample	excluding outliers**
Fix	1.61	1.53
Peg	1.60	1.60
Managed Float	2.84	2.56
Float	2.59	2.59
Free Falling	7.35	5.38

**average by exchange rate regime of monthly volatility*
monthly Volatility = standard deviation of change in RER computed over a year
***excluding the 1% upper tail of each distribution of monthly volatility*

Average Annual Volatility (%) of Real Effective Exchange Rate and Selected Aggregate Variables*

Variable	Full sample	ithout free falling years
Volatility of Real Effective Exchange Rate	18.01	15.45
Volatility of Real Per Capita Output Growth	4.55	3.78
Volatility of CPI inflation	16.35	7.24
Volatility of Term of Trade Growth	10.65	9.71
Volatility of Fiscal Expenditures over GDP	9.93	8.06
Volatility of Trade Weighted Comodity Price Cha	7.59	7.53

** cross-sectional average of the standard deviation computed for each variable in each country over 1960-2000*